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**CONTINUED ELECTROMAGNETIC PROTECTION
INTEGRITY OF AIRCRAFT AND SYSTEMS - PHASE II
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EFFECTS OF LOOSENING CONNECTOR BACKSHELLS

The backshell loosening tests for FAA/NIAR TASK TWO of ìContinued Electromagnetic Protection Integrity of Aircraft and Systems, Phase-IIî research was conducted to study the degrading effects on the electrical characteristics of the shielding caused by loosening of the connector backshells. The test process involved three steps carried out on two different types of backshells, type A and type B. Connector type A, shown in figure 1a, had a small backshell and was designed to provide easy visual inspection of the shield bonding. Connector type B, shown in figure 1b, had a large backshell and was designed to provide maximum HIRF protection. In the beginning of the testing, the loop impedance values and tightness of the backshells were recorded as pre-test conditions, and then tightened to manufactureís specifications. In the second step, the backshells were gradually loosened by degree turn and the loop impedance of the wire bundles, connected to the backshell under test, was measured at each increment. In the third step, the backshells were loosened according to percent of torque specifications and the loop impedance of the wire bundles was measured at each increment.

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(a)

(b)

FIGURE 1. BACKSHELL: a) TYPE A; AND b) TYPE B.

In addition to electrical impedance measurements, used to indicate a loose backshell via shield degradation, visual inspection was also performed. Three different visual inspection methods were used:

- The initial visible threads on the backshell were taken as a reference after tightening the backshell to the manufacturer's specification. During different stages of testing, the backshell was visually observed and as soon as an additional thread was clearly seen, the backshell was declared ***thread loose***.
- Both the backshell and connector were marked after torquing the backshell to manufacturer's specification. This mark was considered as a reference for observing the deviation of the backshell from initial position. During different stages of testing, the backshell was visually observed and as soon as there was a deviation from the mark reference, it was declared ***visually loose***.
- Each backshell was tightened to manufacturer's specification and connected to the test panel. They were then checked for hand looseness by applying a force in the opposite direction by hand. During different stages of testing, the hand force was applied after the backshell was fitted back on the test panel. As soon as the backshell was movable by hand, it was declared ***hand loose***. The range of the force applied by hand was measured through experimentation and was found to be between 15 to 18 inch-pounds.

Following is a summary of results, after conducting the backshell loosening tests and evaluating the data:

- Loosening of a backshell will eventually result in a significant reduction of shield effectiveness as measured by an increase in the loop impedance of the wire bundle.
- Backshell type A became visually loose and hand loose before any significant increase in loop impedance could be electrically measured.
- Backshell type B became visually loose before, and hand loose before or at, any significant increase in loop impedance could be electrically measured.
- For both panel types, the backshells became thread loose at or before any significant increase in loop impedance could be electrically measured.
- The check for visual looseness and hand looseness is only possible if the backshells are visually and physically accessible on aircraft.

Following are recommendations derived from the test results:

- Connector backshells need to be checked for looseness during scheduled maintenance.
- A visual inspection using a mark reference, to indicate any loosening of the backshell is the most effective method for the two types of backshells studied. This mark can be made with a wax/silicon bead, a permanent marker, etc.
- If the backshells are not marked, a check for hand looseness should be performed during scheduled maintenance.
- A visual inspection with no mark reference (thread loose) is not recommended in determining backshell looseness, because it is subjective and requires a known reference for the position of the backshell at full torque.

- During routine maintenance, a loop impedance measurement should be made on wire bundles, when their backshells are not visually or physically accessible.